Aalto University
School of Business

Relation between board composition and firm performance

Empirical evidence from Nordics

Bachelor's Thesis
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Finance
Fall 2019

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Title of thesis Relation between board composition and firm performance: Empirical evidence from Nordics

Degree Bachelor of Science

Degree programme Finance

Thesis advisor(s) Michael Ungeheuer

Year of approval 2019 **Number of pages** 24 **Language** English

Abstract

I study the relationship between the composition of board of directors and company performance on two measures: Tobin's Q and ROA. Using a panel data sample of more than 400 Finnish, Danish and Swedish companies over the years 2012-2018, I employ pooled OLS estimator and fixed effects regressions using firm and year fixed effects. I find significant evidence supporting my hypothesis that board size has a negative correlation with firm performance, measured with Tobin's Q. On the contrary, I find only a little significance between board size and ROA. I also find a weak significant relation between the number of foreign directors and firm value. These findings are robust to foreseeable covariates, multicollinearity, heteroscedasticity, and omitted variables. These results contribute to the existing literature on corporate governance by providing robust evidence on a unique data set of Nordic countries in post-financial crisis markets.

Keywords board of directors, board composition, board size, foreign directors, corporate governance, firm performance

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1. Introduction

In modern companies, board of directors are in the center of corporate governance and supervision of executive management. Board of directors has been the response to the widely discussed agency problems. They could be seen as the middleman between shareholders, bondholders and executive management. Good corporate governance should help companies to overcome agency problems and affect firm performance in a positive manner. One main question about corporate governance is what the optimal composition of the board of directors is. In this paper, I examine the relationship between board composition and firm performance using a unique dataset of Nordic firms from 2012 to 2018.

1.1 Background and motivation

A number of previous studies have examined how different corporate governance variables affect the performance of the company[1]. There is a large amount of literature on many aspects of the board of directors and the attributes of boards. Most of the previous literature is based on time series before the 21st century and they are mainly US-based. Technology and corporate governance have developed substantially compared to the time before the 21st century. Also, corporate governance practices differ a lot between countries and regions. None of the studies found on top journals uses data from Nordic companies in post-financial crisis economy.

1.2 Contribution to existing literature

In this paper, I contribute to the mainly US-based literature examining the relationship between corporate governance and firm performance with a unique sample of Nordic Large and Mid cap[2] firms on post-financial markets. My dataset consists of 1,998 firm-year observations of many different variables. By including a broad panel dataset, I allow myself to use relevant econometric methods to control for endogeneity and ensure that my results are less likely to be biased by a specific time period. As the previous literature has been mostly from the dataset before the 21st century, my paper will offer knowledge if the relationship between composition of board of directors and firm performance still exists.

1.3 Main findings

My main findings are the following: I find strong evidence of a negative relationship between Board size and Tobin's Q. This main result proves robust to many different regression models.

[1] See e.g. Pfeffer, 1972; Yermack, 1996; Mak & Li, 2001; Bonn et al., 2004; Wintoki et al., 2009; Guest, 2009
[2] Nordic Large and Mid Cap consists of firms with a market value over MEUR 150

On the other hand, I find weak significance between the amount of foreign directors and Tobin's Q. The relationship between the amount of foreign directors and Tobin's Q is positive. I also employ ROA as another dependent variable. The relationship with Board size and ROA is negative but I find only weak significance. I do not find any significance between the amount of foreign directors and ROA. I use pooled OLS estimator and apply fixed effects model to control for omitted variable bias and endogeneity. My findings imply that optimal Board size is as low as possible measured with Tobin's Q or ROA. I also find that the negative relationship between board size and performance is stronger with large firms who have larger boards.

1.4 Limitations of this study

As I am using pooled OLS and fixed effects estimators in this study, it will create some limitations. OLS and fixed effects will perform poorly if there are excessive outliers. To control for outliers I have winsorized my data and used additional regressions for robustness checks. Both of my regressions are linear and most of the systems, in reality, are not linear. In this study, I try to avoid this problem by using natural logarithms of certain variables. The least-squares method will also lead to unacceptable results if the used variables are highly correlated with each other. I will compute a pairwise correlation matrix and analyze the correlations to see if the variables that I choose are the correct ones. Wintoki, Linck & Netter (2012) also show that OLS and fixed effects regressions do not control for all types of endogeneity in corporate governance studies and dynamic models should be used. Based on the previous literature by Guest (2009) and Ammann, Oesch & Schmid (2011), I will assume that my models are not driven by dynamic endogeneity and use static regression models in my main analysis. I will also employ a dynamic GMM estimator as robustness check.

1.5 Structure of this study

The paper proceeds as follows. In section 2 I review the literature on board of directors' operation and structure, as well as the relationship between board composition & firm performance and construct my hypothesis based on the previous literature. In section 3 I describe the data I have used in this study and section 4 reviews the methodology applied with my data. Section 5 presents the empirical results from my main analysis and section 6 will offer additional analysis as well as robustness checks. Section 7 concludes the study.

2. Theoretical Background and Hypotheses

2.1. Literature review

2.1.1. Function of corporate board

Board of directors has been a largely researched topic in corporate finance studies as they have a central role in a corporation. Corporate governance practices may vary a lot between countries based on many different factors, like the nature of the financial markets, the time of the definitions, corporate culture and the theory used to characterize such practices (Kaczmarek, Kimino & Pye, 2012). As Coles, Daniel & Naveen (2007) say in their paper: "The board of directors of a corporation is meant to perform the critical functions of monitoring and advising top management.", beside the fact that the board is monitoring the top management of corporation is functioning as it should, board's role is also to make major decisions affecting the company's future performance and advise the top management in its actions.

In the Nordic countries, corporate governance includes high governance ratings and minimum levels of corruption. There is a clear difference between a board of directors and executive management which is also described as a two-tier governance model. On the other hand, board of directors in Nordics is not limited to the supervision and can interfere in a company's actions. (Thomsen, 2016) This differs from the U.S. or U.K. usual one-tier model. In Nordics, the amount of independent directors is much higher compared to the U.S. or U.K. (Oxelheim, Gregorič & Randøy, 2013). These high differences between corporate governance practices increase the motivation to study board of directors in different geographical areas.

The majority of research studying board of directors and the functions they have is examining the relationship between board-specific characteristics and company performance. The explaining variable is usually some board-specific character for example board independence, board size, board diversity or board ownership and the dependent variable is usually some market-based or accounting-based variable, for example, Tobin's Q, return on equity, return on assets or market return.[3]

2.1.2. Board size and performance

The relationship between board size and firm performance have had mixed outcomes. Yermack (1996) found evidence that board size has a negative impact on the performance of the company. He used OLS and fixed effects regressions to estimate optimal size for board measured by Tobin's Q. Eisenberg, Sundgren and Wells (1998) have found similar results as Yermack (1996). They studied the relationship between board size and financial performance in small and midsize

[3] See Yermack (1996), Coles, Daniel & Naveen (2007), Guest (2009) and Wintoki, Linck & Netter (2012)

Finnish firms and found as well negative relation between board size and firm performance using industry-adjusted return on assets. They both conclude the problem to derive from the fact that the problems of communication and decision making increase as the board size increases. This affects the ability of the board to control management and by that leading to agency problems arising from the disengagement of management and control.

At the start of the century, Mak & Yuanto (2003) also found a negative relationship between board size and firm performance by using data of Singapore and Malaysian firms. Guest (2009) also provided results of a negative relation between board size and firm performance on U.K. based firms.

Coles, Daniel & Naveen (2008) found that the relationship between firm value and board size is U-shaped, suggesting that either very small or very large boards are optimal. They showed that the relation arose from differences between complex and simple firms. Based on their findings, for complex firms, larger board size would optimal and for simple firms, smaller board size would be optimal.

On the contrary, there is also a broad amount of literature that has found a positive relationship between board size and firm performance. For example, Fayzi & Locke (2012) found a positive relation to New Zealand's listed firms. Also, Boone, Field, Karpoff & Raheja (2007) showed a positive relation between board size and performance. Most of the studies argue that the more we have directors the more information we have on the board and therefore they will come up with more robust solutions to major decisions.

The debate on what is the effect of board size on firm performance is still ongoing and new research on corporate governance comes on a rapid basis. The majority of the studies that imply significance between board size and performance suggest a negative relationship.

2.1.3. Foreign directors and performance

The amount of foreign directors on corporate boards is not as a research topic as the board size itself. Masulis, Wang & Xie (2012) show that U.S. based firms with foreign independent directors make better cross-border acquisitions when the target company is from the director's home region. On the other hand, they show that firms with foreign directors suffer from a poorer performance. Choi, Sul & Min (2012) also found positive relations between foreign directors and firm value in Korean firms.

In the Nordics, board rooms seem to be surprisingly homogenous in terms of nationality. Randøy,

Thomsen & Oxelheim (2006) did not found any significance between board diversity and firm performance in terms of nationality while using data from Nordics. They also state that greater board diversity did not come in the cost of lower performance. Hahn & Lasfer (2016) found on U.K. firms that foreign non-executive directors do add value when the meeting frequency of a firm is high. Most of the studies on the diversity of nationality on board have not found any significance and those who have found are contradictory with each other.

2.1.4. Problem of endogeneity in corporate governance studies

The problem of endogeneity in corporate governance studies has been a largely discussed topic. As Wintoki, Linck & Netter (2012) show in their paper, empirical corporate governance research often has a large number of issues with endogeneity. They see that there are three types of endogeneity in corporate governance studies: 1. Dynamic endogeneity 2. Simultaneity 3. Unobserved heterogeneity. They also point out that widely used instrumental variable (IV) regressions are not valid for corporate governance studies as there are hardly any strictly exogenous variables that would correlate with independent variables but not with the dependent variable. Also Stock & Yogo (2002) show in their paper that using invalid instruments in IV regressions will result in biased estimators for the model. Wintoki, Linck & Netter (2012) suggest using well developed dynamic generalized methods of moments to control for all types of endogeneity.

Guest (2009) employed suggested methods by Wintoki, Linck & Netter (2012)[4] and many other authors and studied the relationship using both instrumental variable analysis and generalized methods of moments. His findings show that the relationship between corporate governance and performance is not driven by unobserved firm effects, simultaneous endogeneity or dynamic endogeneity as Wintoki, Linck & Netter (2012) suggested. He also shows that the variables widely used for instrumental variables analysis are endogenous and invalid. Based on his findings, the use of IV regressions in corporate governance research will result in biased results.

Also, Ammann, Oesch & Schmid (2011) studied the relationship between corporate governance and firm value from 22 developed countries over the period from 2003 to 2007. By using a dynamic GMM estimator as proposed by Arellano & Bover (1995) and Blundell & Bond (1998), they found a significant relationship between corporate governance and firm performance. These findings ease the endogeneity concerns in corporate governance studies.

[4] Wintoki, Linck & Netter had published a previous version of this article already in 2007 so Guest (2009) had the change to use the methods.

2.2. Hypothesis

This section will go through the research question and hypotheses of this thesis. Board of directors' characteristics and firm performance is a largely studied topic of corporate governance study, but most of the studies are based on UK or U.S. firms and the period is before the 21st century. None have addressed the relationship between the board of directors and firm performance in Nordic countries and the time period being after 2010. Due to these considerations, I will study the relationship between the size of board of directors and firm performance, using several different regression models on a unique data set of Nordic companies.

In a study, Zahra & Pearce (1989) divided board attributes into four broader categories. In this study, I have also used the model from Zahra & Pearce (1989) and divided board attributes as shown in Table 1. In this paper, I will focus on the effect of composition of a board of directors. I will construct hypotheses about board composition using board size and amount of foreign directors.

2.2.1. Board Size

The previous literature reviewed above has not been consistent on the question does board size has a positive or negative effect on firm performance. The consensus has still been that board size has a negative effect on firm performance, as Yermack (1996), Wu (2000), Guest (2009) and Kumar & Singh (2013) suggest. This is mostly due to the assumption that firm value depends on the quality and efficiency of decision-making and monitoring by the board of directors. Smaller groups can be more effective and, as Guest (2009) mentions, larger boards are usually related to free-rider problems and higher coordination costs. Based on this, the first hypothesis is formulated as follows:

H1*: Number of board of directors is negatively correlated with firm performance.*

2.2.2. Amount of foreign directors

Following the past literature discussed above, the proportion of foreign directors could have either a positive or negative effect on the performance of a firm. The past literature has not found high consistent significance between board diversity and firm performance from the perspective of foreign directors. Based on this, the second hypothesis is formulated as follows:

H2*: Amount of foreign directors do not have significant effect on firm performance.*

Table 1

Board attributes divided into categories. This table reports board attributes I use in my regressions. These categories were first introduced by Zahra & Pearce (1989).

Category	**Variable**
Composition	Board size, Amount of foreign board members
Characteristics	Board Independence
Structure	Board ownership
Process	Board meeting activity, Audit committee meeting activity

3. Data

3.1. Sample construction

The source for my sample of Nordic publicly traded firms for governance variables is an external provider and for financial variables, the source is Datastream, from which financial variables are derived. The external provider is a consulting firm specialized in corporate governance in Nordics called Alexander Incentives[5]. They have a large database of executive compensation metrics and governance variables from Nordic Countries.

From Alexander Incentives database, I start out with 21,432 person-year observations of many different variables. I constructed my dataset so that I have only firm-year observations from all variables. I restricted my sample of firms to Danish, Swedish and Finnish companies as the sample of Norwegian firms was lacking information. I also restricted my sample of firms to Large and Mid Cap companies as the sample from governance variables had mainly Small Cap companies from Finland included. Another reason for excluding Small Cap companies is that corporate governance in Small Cap companies varies a lot compared to larger companies, as

[5] Alexander Incentives is a Finnish consultancy specialized in executive compensation and corporate governance surveys in Nordics.

Aaboen, Lindelöf, von Koch & Löfsten (2006) and Linck, Netter & Yang (2008) showed. I base my empirical analysis from 2012 onwards.

A study by Elton, Gruber, & Blake (1996) shows that survivorship bias can lead to overly optimistic results because failures are ignored. I have included all firms that have been delisted due to acquisition or bankruptcy during the time period. I have checked all of the active firms on a yearly basis. Because of this the sample will not have a survivorship bias and does not exclude companies that performed the worse during the period. My final sample consists of a panel of 1,998 firm-year observations from 2012 to 2018. Table 2 is the presentation of summary statistics for all the variables used in the regression analysis.

3.2. Dependent and independent variables

Based on the methods of related studies, such as Barnhart et al. (1994), Yermack (1996), Mak & Li (2001) and Coles et al. (2008), I will use a market-based variable as well as accounting-based variable as the dependent variable. My key dependent variable is Tobin's Q. *Tobin's Q* (1) is determined as the ratio of a firm's market value divided by the replacement cost of assets. I have calculated Tobin's Q in this study as follows.

$$Tobin's\ Q_{i,t} = \frac{BVD_{i,t}+MVE_{i,t}}{BVA_{i,t}} \quad (1)$$

where $BVD_{i,t}$ is the book value of total debt on year *t* for firm *i*

$MVE_{i,t}$ is the market value of common equity on year *t* for firm *i*

$BVA_{i,t}$ is the book value of on year *t* assets for firm *i*

Boone, Field, Karpoff & Raheja (2007), Linck, Netter & Yang (2008), and Lehn, Patro & Zhao (2008) provide empirical evidence on why Tobin's Q can be a problem as a measure of firm performance. Wintoki, Linck and Netter (2012) argue that "Tobin's Q is a proxy for growth opportunities, and growth opportunities are a cause, rather than a consequence, of governance structures."

Table 2

Sample summary statistics. This table report sample summary statistics for 1,998 firm-year observations from 2012 to 2018. Companies are from Finland, Sweden or Denmark. Sample includes only data from Large and Mid Cap companies. All of the governance variables are gathered from Alexander Incentive's large database. All of the financial variables are gathered from the Datastream. *Tobin's Q* is calculated using the Eq. 1 and *ROA* is calculated using the Eq.2. *Board size* is the number of directors chosen by annual general meeting. *%-Foreign directors* is calculated by dividing number of foreign directors by total number of directors. *Board meetings* is total number of board meetings per fiscal year. *Committee meetings* is total number of committee meetings per fiscal year. %-*Board ownership* is the total amount of ownership that board members have of the company presented as a percentage of the total market value of equity. *%-Board independence* is the percentage amount of directors that are independent of the company. Size is the market value of a company. *Debt* is the sum of long-term debt, short-term debt and current portion of long-term debt, divided by total capital, short-term debt and preference capital. *Capex* is capital expenditures divided by total sales.

Variable	n	Mean	St. Dev.	Min	Q1	Median	Q3	Max
Measures of performance								
Tobin's Q	1,998	1.57	1.99	0.05	0.53	0.95	1.74	11.61
ROA	1,998	0.06	0.09	-0.3	0.03	0.06	0.09	0.39
Governance Variables								
Board Size	1,998	7.04	1.49	4	6	7	8	11
%-Foreign directors	1,998	22	26	0	0	14	32	100
Board Meetings	1,998	11.63	4.59	5	9	11	14	29.03
Committee Meetings	1,998	8.64	5.9	0	5	8	11	29
%-Board Ownership	1,886	10	16	0	0	1	13	67
%-Board independence	1,783	84	18	21	75	88	100	100
Company characteristics								
Size (MEUR)	1,998	3,677.53	7,276.73	104.4	382.96	927.38	3,058.27	43,429.8
Debt	1,998	0.36	0.21	0	0.2	0.36	0.48	0.92
Capex	1,998	0.12	0.32	0	0.02	0.03	0.05	1.88

In addition to Tobin's Q, in this study, I use another performance measure as the dependent variable for robustness. Yermack's (1996) study notes that his findings of board size and firm value are mirrored in firm profitability. I use *return on assets (ROA)* (2) to measure firm performance. I have calculated ROA in this study as follows.

$$ROA_{i,t} = \frac{Net\ Income\ (Loss)}{Average\ of\ Last\ Years\ and\ Current\ Years\ Total\ Assets} \qquad (2)$$

As independent variables, I use governance variables that represent attributes of boards of directors presented in Table 1. My key independent variable is *board size*. In my sample, I have only included directors chosen by the annual general meeting and excluded all other directors for example employee representative. This is because, in Nordic corporate governance, employee representatives do not have the same authority as members chosen by the annual general meeting. In the study, I have used the natural logarithm of the total number of directors. Fig. 1 illustrates the mean and median values of Tobin's Q for companies sorted by board size. The median and mean of Tobin's Q values decline almost monotonically over the scope of board sizes. The median Tobin's Q only increases when changing from 5 to 6 directors. For companies with seven or fewer directors, mean Tobin's Q value is above 1.5. For companies with over 7 directors, the mean Tobin's Q value is below 1.5.

Following the related literature, Yermack (1996), Mak & Li (2001), Coles, Daniel and Naveen (2008) and Vafeas & Vlittis (2019), I use another governance variables as the independent variable for explaining the performance of firms. As another measure of board attributes, I use *Foreign directors*. A foreign director is someone whose nationality is different from the companies' country of main exchange. The *Foreign directors* is calculated by dividing a number of foreign directors by the total number of directors.

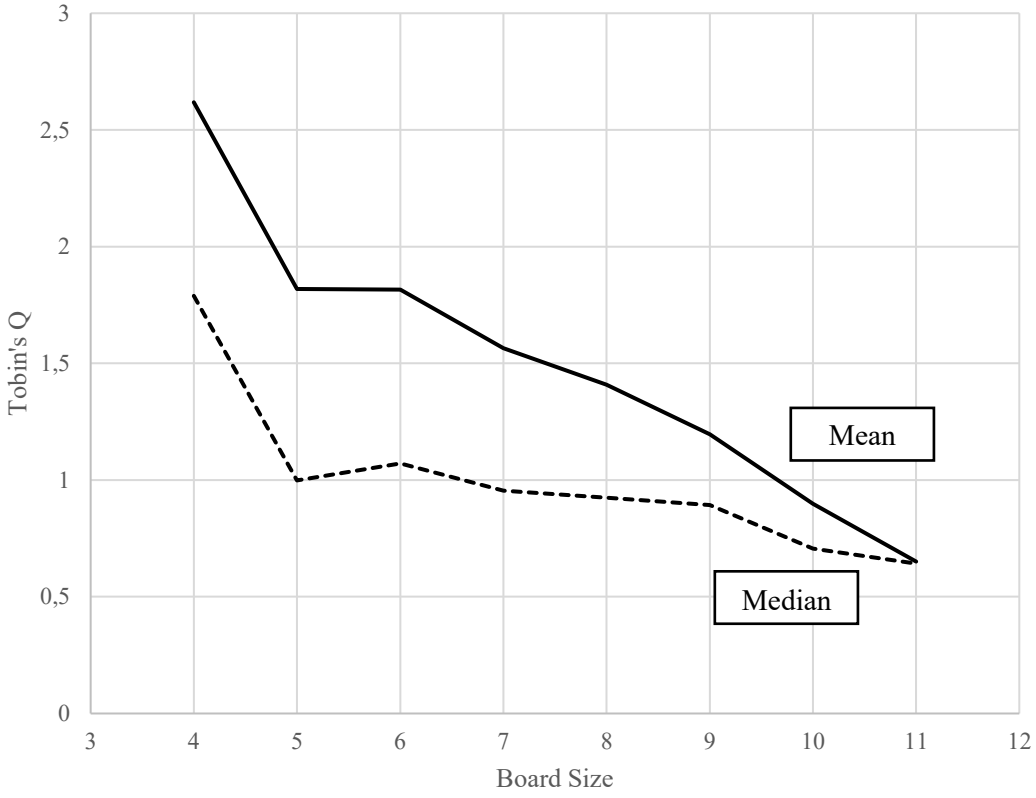
3.3. Control variables

Following previous literature, such as Yermack (1996), Coles, Daniel & Naveen (2008) and Guest (2009), I will include several firm- and board-specific characteristics that may correlate with company's performance as control variables. As discussed in the 2. section I use variables from different categories of board attributes. To control for the process of the board of directors I use *Board meetings* and *Committee meetings* as control variables. *Board meetings* is the total number of board meetings per company in a fiscal year. *Committee meetings* is the total number of committee meetings per company in a fiscal year. To further control for board composition and characteristics I use *Board ownership and Board independence*. *Board ownership* is the total amount of ownership that board members have of the company presented as a percentage of the total market value of equity. *Board independence* is measured by dividing the number of independent directors by the total number of board of directors. In this study, the independent directors are independent of the company but might not be independent of the major shareholders.

This means that independent directors are not employed by the company but might be a major shareholder.

Figure 1.

Board Size and Tobin's Q: Sample means and medians. The sample consist of 1,998 firm-year observations from 2012 to 2018. Data for *Board size* is provided by external provider, Alexander Incentives. Data for *Tobin's Q* is gathered from the datastream. *Tobin's Q* is calculated as Market value of assets divided by replacement cost of assets.



As the past literature, I also control for many company characteristics. *Size* is the natural logarithm of the market value of equity. Controlling for the capital structure of the company is important as it has been shown in the past literature that it has an effect on firm value. *Debt* is the sum of long-term debt, short-term debt and current portion of long-term debt, divided by total capital, short-term debt and preference capital. *ROA* is used also as a control variable for regressions having *Tobin's Q* as the dependent variable. Like Yermack (1996), I also use a lagged control variable ROA_{t-1} and ROA_{t-2} to define that it usually takes time for performance to adjust to changes in operations and to reduce possible autocorrelation and omitted variable bias. According to past literature, as Yermack (1996), Hutchinson (2002) and Hutchinson & Gul

(2004), the firm value depends on future investment opportunities. I use *Capex* as a proxy for investment opportunities. *Capex* is capital expenditure divided by sales. I use it also as a control for growth. All variables are winsorized at the first and 99th percentiles to remove influential outliers.

Additionally, as Yermack (1996), Coles, Daniel & Naveen (2008), Guest (2009) and Masulis, Wnag & Xie (2012), I control for year and industry fixed effects. Controlling for industry fixed effects is specifically important as Tobin's Q and ROA vary a lot between industries and across time. Information about the industries is gathered using two-digit SIC (Standard Industrial Classification) codes. I have constructed a specific factor for every industry per year. This means I have 126 different Industry-Year groups. With this factor, I can control for some industries that have performed poorly some specific year or outperformed other industries in some specific year. As the past literature, I also control for firm fixed effects.

4. Methodology

Following the past literature, as Yermack (1996), Guest (2009) and Ammann, Oesch & Schmid (2011), in my main analysis, I employ pooled ordinary least squares (OLS) and fixed effects linear models with heteroscedasticity-robust standard errors. As I have unbalanced panel data, it is hard to satisfy all the assumptions of OLS. Therefore, fixed effects regression with firm and time fixed effects will be more robust concerning autocorrelation, heteroscedasticity and omitted variable bias. As Guest (2009), I use t-statistics that are based on robust standard errors. The observations are clustered at the firm level. To further take account of multicollinearity in my regressions I compute a pairwise correlation matrix for my variables. The pairwise correlation matrix is shown in table 3.

The pairwise correlations are fairly low but as expected, there is some amount of correlation between chosen explanatory variables. For example, there is a positive correlation between *Board size* and variables *Size* and *Committee meetings*. Overall, larger firms tend to have larger boards and larger boards often arrange their work into committee work, compared to small firms. This is shown as the *Size* has a negative correlation with *Board meetings* and a positive correlation with *Committee meetings*. There is also a negative correlation between *Tobin's Q* and variables *Debt*, *Board meetings,* and *Committee meetings.* If the firm is facing troubles and the market value compared to assets decrease, board of directors tends to convene more often.

Table 3

Pairwise correlations. This table reports the pairwise correlations for variables used in the empirical analyses. *Tobin's Q* is the ratio of a firm's market value divided by replacement cost of assets *Board size* is the number of directors in board selected by the annual general meeting. *Size* is the market value of the equity. *Debt* is the sum of long-term debt, short-term debt and current portion of long-term debt, divided by total capital, short-term debt and preference capital. *Capex* is capital expenditure divided by sales. *Board meeting* is the amount of board meetings per company per fiscal year. *Committee meetings* is the total number of committee meetings per company per fiscal year. *Board ownership* is the total amount of ownership that board members have of the company presented as a percentage of the total market value of equity. Board independence is measured by dividing the number of independent directors by the total number of board of directors. *ROA* is return on assets which is calculated by dividing Net income by average of total assets during the fiscal year. ROA_{t-1} is 1-year lagged value of ROA. ROA_{t-2} is 2-year lagged value of ROA.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Tobin's Q	1												
2. Board size	-0.176	1											
3. Size	0.057	0.509	1										
4. Debt	-0.514	0.093	0.058	1									
5. Capex	-0.150	-0.144	-0.038	0.274	1								
6. Board meetings	-0.235	-0.011	-0.137	0.201	0.062	1							
7. Committee meetings	-0.254	0.420	0.378	0.154	-0.189	0.190	1						
8. Foreign members	0.045	0.214	0.252	0.062	-0.141	-0.024	0.322	1					
9. Board ownership	0.009	-0.074	-0.173	-0.048	0.102	-0.122	-0.308	-0.252	1				
10. Board independence	-0.011	0.061	-0.031	0.069	-0.061	0.135	0.090	0.059	-0.191	1			
11. ROA	0.352	-0.004	0.224	-0.217	-0.027	-0.156	-0.122	-0.036	0.091	-0.039	1		
12. ROA_{t-1}	0.364	-0.042	0.192	-0.240	-0.020	-0.152	-0.134	-0.065	0.093	-0.052	0.670	1	
13. ROA_{t-2}	0.287	-0.011	0.164	-0.205	-0.011	-0.130	-0.112	-0.067	0.117	-0.039	0.561	0.632	1

As Mansfield & Helms (1982) study shows, multicollinearity can reduce the efficiency of the multiple regression analysis. I also create variance inflation factors[6] (VIFs) for my explanatory variables shown in table 4. The VIFs are calculated as follows:

$$VIF_j = \frac{var(\widehat{\beta}_j)}{var(\widehat{\beta}_{j0})} = \frac{1}{1-R_j^2} \quad (3)$$

Table 4

Variance inflation factors table. This table reports calculated variance inflation factors (VIFs). VIFs are calculated with Eq. 3. All of the VIFs are less than 5 which implies that there is no problematic multicollinearity.

Variable	VIF
ln Board Size	1.242
ln Size	1.322
Debt	1.148
Capex	1.191
ROA_t	1.426
ROA_{t-1}	1.580
ROA_{t-2}	1.368
Board meetings	1.107
Committee meetings	1.271
Foreign Directors	1.002
Board ownership	1.112
Board independence	1.050

As all of the VIFs are less than 2, I can continue my analysis without further actions. For my main analysis, I use several different models for the two dependent variables. The empirical models are in the form of the following.

Performance = f(board structure, firm characteristics, fixed effects),

Following the previous literature, as Yermack (1996), Wintoki (2007) and Guest (2009), regressions that I use in this study build on the following basis.

$$\begin{aligned} Performance\ measure = {} & \beta_0 + \beta_1 \ln(Board\ members) + \beta_2 \ln(Size) + \beta_3 Debt + \\ & \beta_4 Capex + \beta_5 ROA_t + \beta_6 ROA_{t-1} + \beta_6 ROA_{t-2} + \beta_7 Board\ meetings + \\ & \beta_8 Committee\ meetings + \beta_9 Foreign\ directors + \beta_{10} Board\ ownership + \\ & \beta_{11} Board\ independence + (Industry\ x\ Year\ dummy) + \varepsilon \end{aligned} \quad (4)$$

[6] Variance inflation factor calculates how much the variance of a predicted regression coefficient is affected by collinearity. VIF 1 being low and >5 being high.

Based on my hypotheses, β_1 should be negative and β_9 should be positive.

At first, I study the relationship between *Board members* and *Tobin's Q* by using models A1 - A6 shown in table 5. Within the models, I use industry x year dummies[7] to control for effects between industries and between years. Regressions A1 – A4 are all pooled OLS regressions. Regression A1 regress *ln Board members* to *Tobin's Q* while controlling for firm characteristics and board process (see section 2.) but not for board composition or characteristics. Regressions A2 - A4 regress ln Board members to Tobin's Q while controlling for all control variables. I omit *Committee meetings* as a control variable from regression A3 for robustness checks. A5 – A6 are fixed effects regressions with firm fixed effects and year fixed effects to control for omitted variable bias meaning unrecognized firm characteristics, unrecognized heterogeneity between years and endogeneity.

The effect of *Board size* to *ROA* is estimated using regression models B1 to B5 shown in table 6. B1 – B3 are pooled OLS estimators. All of them control for *industry-year dummies,* firm-specific variables, and board process variables. B4 - B5 are fixed effects regression controlling for firm fixed effects and year fixed effects. I omit lagged values of ROA in A1 regression to see if there is autocorrelation in the model. All of these regressions are shown and analyzed in section 5.

5. Empirical results

Table 5 reports the results of regression between Board size and Tobin's Q. A1 – A4 are Pooled OLS regressions and A5 – A6 are fixed effects regression with firm and year fixed effects. As mentioned, all of the models are build using heteroscedasticity-robust standard errors. My H1 was that "*: Number of board of directors is negatively correlated with firm performance".* All of the estimated beta coefficients for *Board size* shown in table 5 suggest a negative relationship between *Board size* and *firm performance* at a 1% significance level. The coefficients range from -0.874 to -0.462. The model with the largest amount of controlling (A7) yields a beta coefficient of -0.576. Calculated with A7 model's beta coefficient, as median market capitalization[8] in my

[7] IY Dummies = Industry x Year dummy is constructed by creating separate code for every industry per year. As I have 18 industries and 7 years, it means that I have 126 separate Industry-Year groups.
[8] See table 2

Table 5

Pooled OLS and fixed effects regressions results, effect of *Board size and Foreign directors* to *Tobin's Q.* This table reports regressions results for models A1 – A6. Regression A1 and A5 regress *ln Board members* to *ln Tobin's Q* while controlling for firm characteristics and board process (see section 2.) but not for board composition or characteristics. Regressions A2 - A4 and A6 regress *ln Board members* and *Foreign directors* to *Tobin's Q* while controlling for all control variables. *Committee meetings* is omitted in A3. Models A5 and A6 are fixed effects regressions. T-statistics are based on robust standard errors in which observations are clustered at firm level. *, **, *** represent significance at the 10%, 5% and 1% level.

	Dependent variable: ln Tobin's Q					
	Pooled OLS	*Pooled OLS*	*Pooled OLS*	*Pooled OLS*	*Fixed effects*	*Fixed effects*
	(A1)	(A2)	(A3)	(A4)	(A5)	(A6)
ln Board size	-0.652***	-0.731***	-0.815***	-0.607***	-0.462***	-0.576***
	(0.140)	(0.128)	(0.110)	(0.153)	(0.176)	(0.185)
Foreign directors		0.477***	0.110	0.162		0.335**
		(0.089)	(0.076)	(0.102)		(0.163)
ln Size	0.124***	0.098***	0.090***	0.129***	0.138***	0.160***
	(0.022)	(0.019)	(0.016)	(0.023)	(0.035)	(0.040)
Debt	-1.402***	-1.944***	-1.516***	-1.464***	-1.371***	-1.536***
	(0.152)	(0.146)	(0.119)	(0.161)	(0.201)	(0.219)
Capex	0.297***	-0.197***	0.431***	0.306***	0.386***	0.374***
	(0.082)	(0.073)	(0.059)	(0.083)	(0.095)	(0.098)
ROA_t	1.622***	1.320***	1.612***	1.461***	1.446***	1.144***
	(0.346)	(0.430)	(0.382)	(0.360)	(0.348)	(0.344)
ROA_{t-1}	1.403***	1.083**	1.533***	1.408***	1.170***	1.206***
	(0.310)	(0.424)	(0.396)	(0.331)	(0.325)	(0.325)
ROA_{t-2}	0.099	0.296	-0.087	-0.107	0.211	-0.118
	(0.332)	(0.403)	(0.355)	(0.364)	(0.339)	(0.354)
Board meetings	-0.010*	-0.014**	-0.016***	-0.009	-0.003	0.003
	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
Committee meetings	-0.029***	-0.036***		-0.030***	-0.025***	-0.029***
	(0.005)	(0.004)		(0.005)	(0.005)	(0.006)
Board ownership		-0.302**	0.232**	0.012		0.090
		(0.133)	(0.106)	(0.141)		(0.160)
Board independence		0.328**	0.216*	0.238		0.085
		(0.137)	(0.113)	(0.147)		(0.148)
Constant	0.458	1.339***	0.673***	0.125		
	(0.280)	(0.233)	(0.234)	(0.304)		
IY Dummies	Yes	No	Yes	Yes	Yes	Yes
Observations	1,998	1,682	1,682	1,682	1,998	1,682
R^2	0.616	0.386	0.583	0.600	0.500	0.485
Adjusted R^2	0.600	0.382	0.565	0.583	0.328	0.269
Note:						*p<0.1; **p<0.05; ***p<0.01

sample size is MEUR 927.38 and median board size[9] is 7, if we add one director to the board (*ceteris paribus*) it will decrease our market capitalization by MEUR 68.65.

These findings support my H1 hypothesis and I can reject the null hypothesis that Board size does not have any significant effect on firm performance, measured by Tobin's Q. These findings also support the findings by the previous literature that Board size has a negative relationship with Tobin's Q.

My H2 was that "*Amount of foreign directors do not have significant effect on firm performance".* The results from models A2 and A6 are not totally consistent with the hypothesis. Two out of four models using *foreign members* as an independent variable, found significance and positive correlation between *foreign members* and *Tobin's Q.* However, there are things to consider about these findings. As seen on the table, there is no significant relationship in models A3 and A4. Also, the significance in model A6 is lower (at a 5% confidence level). Most of the coefficients of my control variables are also significant at a 1% level.

As all the regressions show, the high statistical negative significance between committee meetings and Tobin's Q could be explained by the fact that low performing firms' board of directors will convene more often. Especially if the firm is about to face bankruptcy. One interesting finding is Debt ratio has a high negative significant effect on Tobin's Q. This supports the findings of Yazdanfar & Öhman (2015), that a higher debt ratio affects firm value negatively. This is also consistent with the *pecking order theory*, as Myers (1984) shows in his paper. Also as discussed in section 3 while choosing control variables, Capex is a proxy for growth and investment opportunities and as covered in section 2, investment opportunities have a positive effect on firm value. All the regressions A1 – A6 suggests that the more we have investment opportunities (capital expenditure compared to sales) the higher our Tobin's Q is.

On the contrary, when estimating with *ROA* as the dependent variable, I find no significance between *Board size* and *ROA.* As the results in table 6 show, all the significance disappears when I add lagged values of *ROA* to the equation. This suggests autocorrelation as the dependent variable is highly correlated with its lagged values. Only the model B1 supports my H1 as it shows negative significance at a 5% confidence level. These findings do not support my H1 or H2 and I cannot if measured by *ROA*.

[9] See table 2

Table 6

Pooled OLS and fixed effects regressions results, effect of *Board size and Foreign directors* to *ROA*. This table reports regressions results for models B1 – B5. B1 – B3 are pooled OLS estimators. All of them control for industry-year dummies, firm-specific variables and board process variables. B3 and B5 control also for board composition or characteristics. B4 - B5 are fixed effects regression controlling for firm-fixed effects and year-fixed effects. Lagged values of ROA are omitted in A1 regression to see if there is autocorrelation in the model. T-statistics are based on robust standard errors in which observations are clustered at firm level. *, **, *** represent significance at the 10%, 5% and 1% level.

	Dependent variable: ROA				
	Pooled OLS	*Pooled OLS*	*Pooled OLS*	*Fixed effects*	*Fixed effects*
	(B1)	(B2)	(B3)	(B4)	(B5)
ln Board size	-0.039**	-0.009	-0.010	-0.023	-0.024
	(0.018)	(0.010)	(0.010)	(0.015)	(0.017)
Foreign directors			0.009		-0.005
			(0.006)		(0.015)
Size	0.022***	0.008***	0.008***	0.016***	0.017***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)
Debt	-0.085***	-0.022*	-0.019	-0.053***	-0.055**
	(0.021)	(0.012)	(0.012)	(0.018)	(0.022)
Capex	-0.005	-0.006	-0.005	-0.013	-0.012
	(0.009)	(0.005)	(0.005)	(0.010)	(0.011)
ROA_{t-1}		0.509***	0.560***	0.351***	0.375***
		(0.046)	(0.051)	(0.056)	(0.065)
ROA_{t-2}		0.217***	0.175***	0.144***	0.121**
		(0.043)	(0.046)	(0.047)	(0.052)
Board meetings	-0.001	-0.0002	-0.00002	0.0001	0.0003
	(0.001)	(0.0004)	(0.0004)	(0.0005)	(0.001)
Committee meetings	-0.003***	-0.001***	-0.001**	-0.001***	-0.001*
	(0.001)	(0.0003)	(0.0003)	(0.001)	(0.001)
Board ownership			0.004		0.027*
			(0.010)		(0.014)
Board independence			0.003		-0.020
			(0.009)		(0.020)
Constant	-0.007	-0.037*	-0.043*		
	(0.032)	(0.022)	(0.024)		
IY Dummies	Yes	Yes	Yes	Yes	Yes
Observations	1,998	1,998	1,682	1,998	1,682
R^2	0.180	0.520	0.528	0.318	0.315
Adjusted R^2	0.148	0.501	0.508	0.303	0.278

Note: *p<0.1; **p<0.05; ***p<0.01

ROA and *Tobin's Q* are different metrics and therefore my findings and the data suggest that *Board size* has a negative effect on firm value but not on operating profitability. It also suggests that *the amount of foreign directors* has some positive effect on firm value but not on operating profitability.

6. Further analysis and robustness checks

I check if my findings of a negative relationship between board size and Tobin's Q are robust by employing a variety of other different regressions. These robustness checks provide additional information on how my conclusions change when methods and assumptions change.

6.1. Precise specification for the relationship between board composition and performance

As Guest (2009), to further examine the relationship between Board size and firm performance I have included dummy variables for each number of board of directors while controlling with all control variables mentioned in section 3. The results are shown in appendix 1. The results suggest that the smallest possible size for board of directors is the best as the beta coefficients for 5 members is the largest. This effect is present measured either by Tobin's Q or ROA. When measured by Tobin's Q, the larger the board size is the more significant the coefficient is. When measured by ROA, the smaller the board size is, the more significant the coefficient is. These results support findings made by main OLS and fixed effects regressions.

I also divided the amount of foreign directors to 5 different groups and constructed dummy variables for each group as shown in appendix 1. I found significant negative relationship between a low and high amount of foreign directors and Tobin's Q. As my main findings, I found no relationship between foreign directors and ROA. If the amount of foreign directors is between 0% and 20%, the negative relation is significant at a 1% level. If the amount is between 20% and 40% the negative relation is significant at a 5% level and if the amount is between 80% and 100% the positive relation is significant at a 10% level. These results also support findings made in the main analysis by OLS and fixed effects regressions.

6.2. Relationship between board size and performance differs by firm characteristics.

According to the previous literature by Coles, Daniel & Naveen (2008), the impact of board size is different with different types of firms. They argue that for firms that are aged, large and have a high debt ratio, larger board size would be the optimal choice. On the contrary, for complex firms with high R&D and high variance in profitability, small board size may be the right choice. I will employ similar methods as Coles, Daniel & Naveen and Guest (2009), and test the relation with interactive variables between board size and each firm-specific control variable. The results are shown in appendix 2.

*Board size * Size coefficient* is significant, measured either with Tobin's Q or ROA. I find no significance in other coefficients. As the *Board size * Size coefficient* is significantly negative, my data suggests that board size has a larger negative impact on performance in large firms that it has in small firms. This means that large firms could improve performance more than small firms by limiting the number of directors as low as reasonable. I also regressed performance on the amount of foreign directors with interactive variables while controlling for the characteristics mentioned above and found no evidence of a relationship.

6.3. Measurement errors and multicollinearity

Following the previous literature, as Guest (2009), in order to further control for outliers, I employ a quantile regression models (Regression E2 and E3 in table appendix 3) which yields an estimate of −0.547 for the board size coefficient (significant at the 1% level) measured by Tobin's Q and an estimate of -0,004 (significant at the 5% level) measured by ROA. This shows that my model is not affected by endogeneity generated by measurement errors.

I also include regression without *Committee meetings* (A3, E1, E3) as it is relatively highly correlated with many independent variables and the dependent variable. As regressions E1 and E3 show, omitting *Committee meetings* will slightly increase the effect of Board size in both Tobin's Q and ROA.

6.4. Possible dynamic endogeneity in corporate governance

As mentioned in chapter 2, a large concern discussed in studies by Coles, Daniel, & Naveen (2008), Guest (2009) and Wintoki, Linck & Netter (2012) is the endogeneity in corporate

governance studies. As I brought out in section 1, they argue that using only static models and ignoring the dynamic nature of performance relationship in empirical work presents significant concerns.

Many studies have used instrumental variables regression to address this problem. As Wintoki, Linck & Netter (2012) points out, using instrumental variables (IV) regression is not very effective in corporate governance studies as finding instrumental variables that are strictly exogenous is really hard as there is barely any.

As Guest (2009), Ammann, Oesch & Schmid (2011) and Wintoki, Linck & Netter (2012), to control for all of the three types of endogeneity[10] mentioned before, I follow the methods of Wintoki, Linck & Netter (2012) and use dynamic panel GMM estimator as recommended by Arellano & Bover (1995) and Blundell & Bond (1998). The system GMM consists of the following steps: First, I compute the regression equation as a dynamic model that includes lagged performance as a control variable. Then, I estimate the model by GMM and use lagged values of governance and performance variables as instruments. Using the lagged values as instruments controls for reverse causality and simultaneity. I do an assumption in the GMM regression that all the other regressors except Capex and year dummies are endogenous.

The results of this robustness check are aligned with my main findings. I find a significant negative relationship between *Board size* and *Tobin's Q* and significant positive relationship between *Foreign directors* and *Tobin's Q*. I also do not find any significance between my main independent variables and ROA. The test for second-order serial correlation in the first differenced residuals and the Hansen test both yield insignificant P-value which means that there is no serial correlation and the instruments set are valid. Based on these findings I can conclude that my results with Tobin's Q are not driven by dynamic endogeneity, unobserved heterogeneity or simultaneity. All results are shown in Appendix 4.

7. Conclusion

In this thesis, using a unique sample of 1,998 firm-year observations on Nordic firms[11] during 2012 – 2018, I have analyzed the relationship between board composition and firm performance. Based on the previous literature I constructed my hypothesis that Board size has a negative effect

[10] Dynamic endogeneity, unobserved heterogeneity and simultaneity
[11] As mentioned in section 3, by Nordic firms I mean firms from Finland, Sweden and Norway.

on firm performance and the amount of foreign directors has no effects on firm performance. The null hypothesis being that board size has no effect on firm performance and the amount of foreign directors has a significant effect on firm performance. As a measure of performance, I have used Tobin's Q and ROA. Tobin's Q is the ratio of a firm's market value divided by replacement cost of assets and ROA is return on assets. As the previous literature, Tobin's Q and ROA gives this study an adequate representation of firm value and profitability.

By constructing numerous different regressions examining the relationship between board composition and firm performance while controlling for many firm-specific variables, governance variables, firm, industry and year fixed effects, I found significance relationship between Board size and Firm value measured by Tobin's Q. I also find some significance between the amount of foreign directors and firm value measured by Tobin's Q. As examining the relationship between board composition and firm performance by firm characteristics, I find that the board size and firm value effect is more severe in larger firms. In this study I employ pooled OLS estimator and fixed effects regression with heteroscedasticity-robust standard errors. With these models, I am able to control for anticipated board and company characteristics and capture the effects of unanticipated characteristics and macroeconomic phenomena. My findings of the relationship between board size and firm value are robust to foreseeable covariates, multicollinearity, heteroscedasticity, and omitted variables.

The results from this paper have many suggestions for practice and future research. In practice, my results suggest that companies should try to keep the board size as minimum as possible considering the size of the company. The bigger the company gets the higher the effect is. If the company already has a large board, they should recognize the inefficiency problems it creates and tries to improve the efficiency of decision making and communication. Boards should also consider choosing foreign directors to bring diversity and international experience but not on the cost of the number of board of directors. Added foreign directors should replace other director's place on the board.

To further examine reactions of the markets to the announcement of an increase in board size, an event study method could be applied to study abnormal returns around the yearly announcement of board size. This study also offers an opportunity for future research to study the effects of diversity on other parameters. Applying the same methodology future research could study the effect of gender or age diversity. Also, the methodology could be applied to other sets of data to see if a similar relationship can be found in other geographical areas, as the corporate governance practices differ a lot between countries.

References

Ammann, M., Oesch, D., & Schmid, M. M. (2011). Corporate governance and firm value: International evidence. *Journal of Empirical Finance*, 18(1), 36-55.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1), 29-51.

Barnhart, S. W., & Rosenstein, S. (1998). Board composition, managerial ownership, and firm performance: An empirical analysis. *Financial Review*, *33*(4), 1-16.

Baysinger, B. D., & Butler, H. N. (1985). Corporate governance and the board of directors: Performance effects of changes in board composition. *Journal of Law, Economics, & Organization*, 1(1), 101-124.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87(1), 115-143.

Boone, A. L., Field, L. C., Karpoff, J. M., & Raheja, C. G. (2007). The determinants of corporate board size and composition: An empirical analysis. *Journal of financial Economics*, 85(1), 66-101.

Coles, J. L., Daniel, N. D., & Naveen, L. (2008). Boards: Does one size fit all?. *Journal of financial economics*, *87*(2), 329-356.

Darmadi, S. (2011). Board diversity and firm performance: the Indonesian evidence. *Corporate ownership and control Journal*, 8.

Eisenberg, T., Sundgren, S., & Wells, M. T. (1998). Larger board size and decreasing firm value in small firms. *Journal of financial economics*, *48*(1), 35-54.

Elton, E. J., Gruber, M. J., & Blake, C. R. (1996). Survivor bias and mutual fund performance. *The review of financial studies*, *9*(4), 1097-1120.

Erhardt, N. L., Werbel, J. D., & Shrader, C. B. (2003). Board of director diversity and firm financial performance. *Corporate governance: An international review*, 11(2), 102-111.

Fauzi, F., & Locke, S. (2012). Board structure, ownership structure and firm performance: A study of New Zealand listed-firms.

Guest, P. M. (2009). The impact of board size on firm performance: evidence from the UK. *The European Journal of Finance*, 15(4), 385-404.

Hermalin, B. E., & Weisbach, M. S. (1988). The determinants of board composition. *The RAND Journal of Economics*, 589-606.

Hutchinson, M. (2002). An analysis of the association between firms' investment opportunities, board composition and firm performance. *Asia-Pacific Journal of Accounting & Economics*, *9*(1), 17-38.

Hutchinson, M., & Gul, F. A. (2004). Investment opportunity set, corporate governance practices and firm performance. *Journal of corporate finance*, *10*(4), 595-614.

Kaczmarek, S., Kimino, S., & Pye, A. (2012). Board task-related faultlines and firm performance: A decade of evidence. *Corporate Governance: An International Review*, 20(4), 337-351.

Kumar, N., & Singh, J. P. (2013). Effect of board size and promoter ownership on firm value: some empirical findings from India. *Corporate Governance: The international journal of business in society*, 13(1), 88-98.

Lehn, K. M., Patro, S., & Zhao, M. (2009). Determinants of the size and composition of US corporate boards: 1935-2000. *Financial Management*, *38*(4), 747-780.

Linck, J. S., Netter, J. M., & Yang, T. (2008). The determinants of board structure. *Journal of financial economics*, *87*(2), 308-328.

Mak, Y. T., & Li, Y. (2001). Determinants of corporate ownership and board structure: evidence from Singapore. *Journal of Corporate Finance*, *7*(3), 235-256.

Mansfield, E. R., & Helms, B. P. (1982). Detecting multicollinearity. *The American Statistician*, *36*(3a), 158-160.

Masulis, R. W., Wang, C., & Xie, F. (2012). Globalizing the boardroom—The effects of foreign directors on corporate governance and firm performance. *Journal of Accounting and Economics*, 53(3), 527-554.

Mi Choi, H., Sul, W., & Kee Min, S. (2012). Foreign board membership and firm value in Korea. *Management Decision*, 50(2), 207-233.

Myers, S. C. (1984). The capital structure puzzle. *The journal of finance*, 39(3), 574-592.

Oxelheim, L., Gregorič, A., Randøy, T., & Thomsen, S. (2013). On the internationalization of corporate boards: The case of Nordic firms. *Journal of International Business Studies*, 44(3), 173-194.

Pfeffer, J. (1972). Size and composition of corporate boards of directors: The organization and its environment. *Administrative science quarterly*, 218-228.

Reinganum, M. R. (1981). Abnormal returns in small firm portfolios. *Financial Analysts Journal*, *37*(2), 52-56.

Stock, J. H., & Yogo, M. (2002). Testing for weak instruments in linear IV regression

Thomsen, S. (2016). Nordic Corporate Governance Revisited. *Nordic Journal of Business*, *65*(1).

Vafeas, N. (2000). Board structure and the informativeness of earnings. Journal of Accounting and Public policy, 19(2), 139-160.

Vafeas, N., & Vlittis, A. (2019). Board executive committees, board decisions, and firm value. *Journal of Corporate Finance*, *58*, 43-63.

Wintoki, M. B. (2007). Corporate boards and regulation: The effect of the Sarbanes–Oxley Act and the exchange listing requirements on firm value. *Journal of Corporate Finance*, 13(2-3), 229-250.

Wintoki, M. B., Linck, J. S., & Netter, J. M. (2012). Endogeneity and the dynamics of internal corporate governance. *Journal of Financial Economics*, 105(3), 581-606.

Yazdanfar, D., & Öhman, P. (2015). Debt financing and firm performance: an empirical study based on Swedish data. *The Journal of Risk Finance*, 16(1), 102-118.

Yermack, D. (1996). Higher market valuation of companies with a small board of directors. *Journal of financial economics*, *40*(2), 185-211.

Zahra, S. A., & Pearce, J. A. (1989). Boards of directors and corporate financial performance: A review and integrative model. *Journal of management*, 15(2), 291-334.

Appendixes

Appendix 1.

Pooled OLS linear model regression results, effect of *Board size* and *Foreign directors* on *Tobin's Q* and *ROA*. Models C1 and C2 show the effect of *Board size* divided into factors. Models C3 and C4 shows the effects of *Foreign directors* divided into 5 different groups using dummy variables. D1 means values between 0-0.2. D2 means values between 0.2-0.4. D3 means values between 0.4-0.6. D4 means values between 0.6-0.8. D5 means values between 0.8-1. All the models control for board related factors, firm specific factors and industry- & year- fixed effects that have been omitted from the table. Variables are defined in the table 2 above. T-statistics are based on robust standard errors in which observations are clustered at firm level. *, **, *** represent significance at the 10%, 5% and 1% level.

Dependent variable:	**ln Tobin's Q**	**ROA**	**ln Tobin's Q**	**ROA**
	(C1)	(C2)	(C3)	(C4)
Board size 5	0.061	0.028***		
	(0.114)	(0.011)		
Board size 6	-0.025	0.023**		
	(0.108)	(0.010)		
Board size 7	-0.086	0.025**		
	(0.109)	(0.010)		
Board size 8	-0.254**	0.018*		
	(0.112)	(0.011)		
Board size 9	-0.284**	0.016		
	(0.122)	(0.011)		
Board size 10	-0.555***	0.015		
	(0.130)	(0.012)		
Board size 11	-0.602***	-0.001		
	(0.154)	(0.014)		
Foreign members D1			-0.252***	-0.005
			(0.097)	(0.009)
Foreign members D2			-0.263**	-0.011
			(0.104)	(0.010)
Foreign members D3			0.075	0.006
			(0.059)	(0.005)
Foreign members D4			0.086	0.008
			(0.079)	(0.007)
Foreign members D5			0.185*	-0.001
			(0.099)	(0.009)
Constant	-0.807***	-0.081***	-0.379*	-0.046**
	(0.209)	(0.020)	(0.204)	(0.019)
Observations	1,998	1,998	1,998	1,998
R^2	0.610	0.524	0.601	0.521
Adjusted R^2	0.593	0.503	0.584	0.501
Note:				*p<0.1; **p<0.05; ***p<0.01

Appendix 2.

Pooled OLS linear model regression results, effect of *Board size and* to Tobin's Q and ROA using interactive variables between board size and each firm specific control variable. This table reports the results of two regressions made to further analyze if the impact of board size to firm performance will differ for different tyes of firms. All of the variables are described in the table 2. Both models control for board related factors, firm specific factors and industry- & year- fixed effects that have been omitted from the table. T-statistics are based on robust standard errors in which observations are clustered at firm level. *, **, *** represent significance at the 10%, 5% and 1% level.

Dependent variable:	**ln Tobin's Q**	**ROA**
	(D1)	(D2)
ln Board size	1.044**	0.144***
	(0.447)	(0.034)
ln Size	0.664***	0.049***
	(0.124)	(0.009)
Debt	-0.903	0.023
	(0.856)	(0.065)
Capex	-1.805***	0.062
	(0.604)	(0.046)
ROA_{t-1}	2.273***	0.512***
	(0.290)	(0.022)
ROA_{t-2}	0.526**	0.207***
	(0.266)	(0.020)
ln Board size * ln Size	-0.277***	-0.021***
	(0.061)	(0.005)
ln Board size * Debt	-0.612	-0.024
	(0.435)	(0.033)
ln Board size * Capex	0.888***	-0.035
	(0.331)	(0.025)
Constant	-2.388***	-0.312***
	(0.877)	(0.066)
Observations	1,998	1,998
R^2	0.369	0.498
Adjusted R^2	0.366	0.495
Note:		*p<0.1; **p<0.05; ***p<0.01

Appendix 3.

Pooled OLS and quantile linear model regression results, effect of *Board size* and *Foreign directors* to *Tobin's Q* and *ROA*. This table reports the results of two OLS regressions and two quantile regressions to test the robustness of my findings. All of the variables are described in the table 2. Models E1 and E3 are regressions omitting *Committee meetings* as control variable. Models E2 and E4 are quantile regressions using all control variables described in the table 2. All of the models industry- & year- fixed effects. T-statistics are based on robust standard errors in which observations are clustered at firm level. *, **, *** represent significance at the 10%, 5% and 1% level.

Dependent variable:	**ln Tobin's Q**		**ROA**	
	Pooled OLS	*Quantile regression*	*Pooled OLS*	*Quantile regression*
	(E1)	(E2)	(E3)	(E4)
ln Board size	-0.828***	-0.547***	-0.015*	-0.004**
	(0.138)	(0.090)	(0.008)	(0.002)
ln Size	0.086***	0.081***	0.007***	0.001***
	(0.022)	(0.012)	(0.001)	(0.0003)
Debt	-1.472***	-1.714***	-0.025***	-0.017***
	(0.156)	(0.064)	(0.008)	(0.002)
Capex	0.412***	-0.347***	-0.003	0.002
	(0.080)	(0.047)	(0.005)	(0.002)
ROA_t	1.783***	2.080***		
	(0.346)	(0.197)		
ROA_{t-1}	1.491***	2.004***	0.514***	0.693***
	(0.325)	(0.204)	(0.023)	(0.005)
ROA_{t-2}	0.175	1.098***	0.220***	0.167***
	(0.350)	(0.224)	(0.021)	(0.004)
Board meetings	-0.017***	-0.012***	-0.0004	-0.00001
	(0.006)	(0.004)	(0.0003)	(0.0001)
Committee meetings		-0.029***		-0.0001
		(0.004)		(0.0001)
Foreign members		0.297***		-0.0004
		(0.061)		(0.001)
Board ownership		-0.295***		-0.003*
		(0.108)		(0.002)
Board independence		0.208*		0.002
		(0.116)		(0.002)
Constant	0.934***	0.748***	-0.021	0.014***
	(0.284)	(0.202)	(0.021)	(0.004)
Year Dummies	Yes	Yes	Yes	Yes
Observations	1,998	1,682	1,998	1,682
R^2	0.599		0.518	
Adjusted R^2	0.583		0.499	
Note:				*p<0.1; **p<0.05; ***p<0.01

Appendix 4.

Generalized methods of moments regression results, effect of *Board size and Foreign directors* to Tobin's Q and *ROA.* This table reports results from GMM regressions measuring the effect of *Board size* and *Foreign members* on *Tobin's Q* and *ROA*. Variables are defined in the table 2 above. T-statistics are based on robust standard errors in which observations are clustered at firm level. *, **, *** represent significance at the 10%, 5% and 1% level. AR(2) is test for second-order serial correlation in the first-differenced residuals, under the null hypothesis that all instruments are valid. Hansen test of exogeneity is under the null hypothesis that instruments used in the GMM are valid.

Dependent variable:	**ln Tobin's Q**	**ROA**
	GMM	*GMM*
	(F1)	(F2)
ln Board size	-0.925**	-0.007
	(0.457)	(0.033)
ln Size	0.059	0.012**
	(0.054)	(0.005)
Debt	-2.453***	-0.036**
	(0.389)	(0.020)
Capex	-0.089	-0.006
	(0.118)	(0.006)
ROA_t	1.892*	
	(1.144)	
ROA_{t-1}	1.143	0.401***
	(0.779)	(0.110)
ROA_{t-2}	0.574	0.156
	(0.568)	(0.103)
Board meetings	-0.020	-0.0004
	(0.019)	(0.001)
Committee meetings	-0.039***	-0.002***
	(0.013)	(0.001)
Foreign members	1.162***	0.015
	(0.285)	(0.015)
Board ownership	-1.176**	0.027
	(0.562)	(0.029)
Board independence	-0.046	-0.034
	(0.400)	(0.029)
Constant	2.434***	-0.011
	(0.828)	(0.048)
Observations	1,998	1,998
AR(2)	0.909	0.959
The Hansen test	0.289	0.602
Note:		*p<0.1; **p<0.05; ***p<0.01